Apprenticeship and Industry Training

Appliance Service Technician

Apprenticeship Course Outline

2315 (2015)

Alberta

Apprenticeship and Industry Training

INNOVATION AND ADVANCED EDUCATION CATALOGUING IN PUBLICATION DATA

Apprenticeship and Industry Training: Appliance Service Technician Apprenticeship Course Outline

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Appliance Service Technician
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Course Outline

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Appliance Service Technician Provincial Apprenticeship Committee.

The graduate of the Appliance Service Technician apprenticeship program is a certified journeyperson who will be able to:

- responsibly do all work tasks expected of a journeyperson
- supervise, train and coach apprentices
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Appliance Service Technician PAC Members at the Time of Publication

Mr. K. Gourlay	Medicine Hat	Presiding Officer
Mr. D. Carew	Edmonton	Employer
Mr. J. Griep	Edmonton	Employer
Mr. C. Ford	Calgary	Employer
Mr. D. Brewka	Edmonton	Employee
Ms. L. Clark	Leduc	Employee
Mr. R. Foo	Calgary	Employee

Alberta Government

Alberta Advanced Education works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

> **The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act*.**

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.alberta.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Occupational Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Occupational Health and Safety (a division of Alberta Human Services) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.albertahumanservices.ca

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Appliance Service Technician apprenticeship technical training:

Southern Alberta Institute of Technology
(Main Campus)

Procedures for Recommending Revisions to the Course Outline

Advanced Education has prepared this course outline in partnership with the Appliance Service Technician Provincial Apprenticeship Committee.

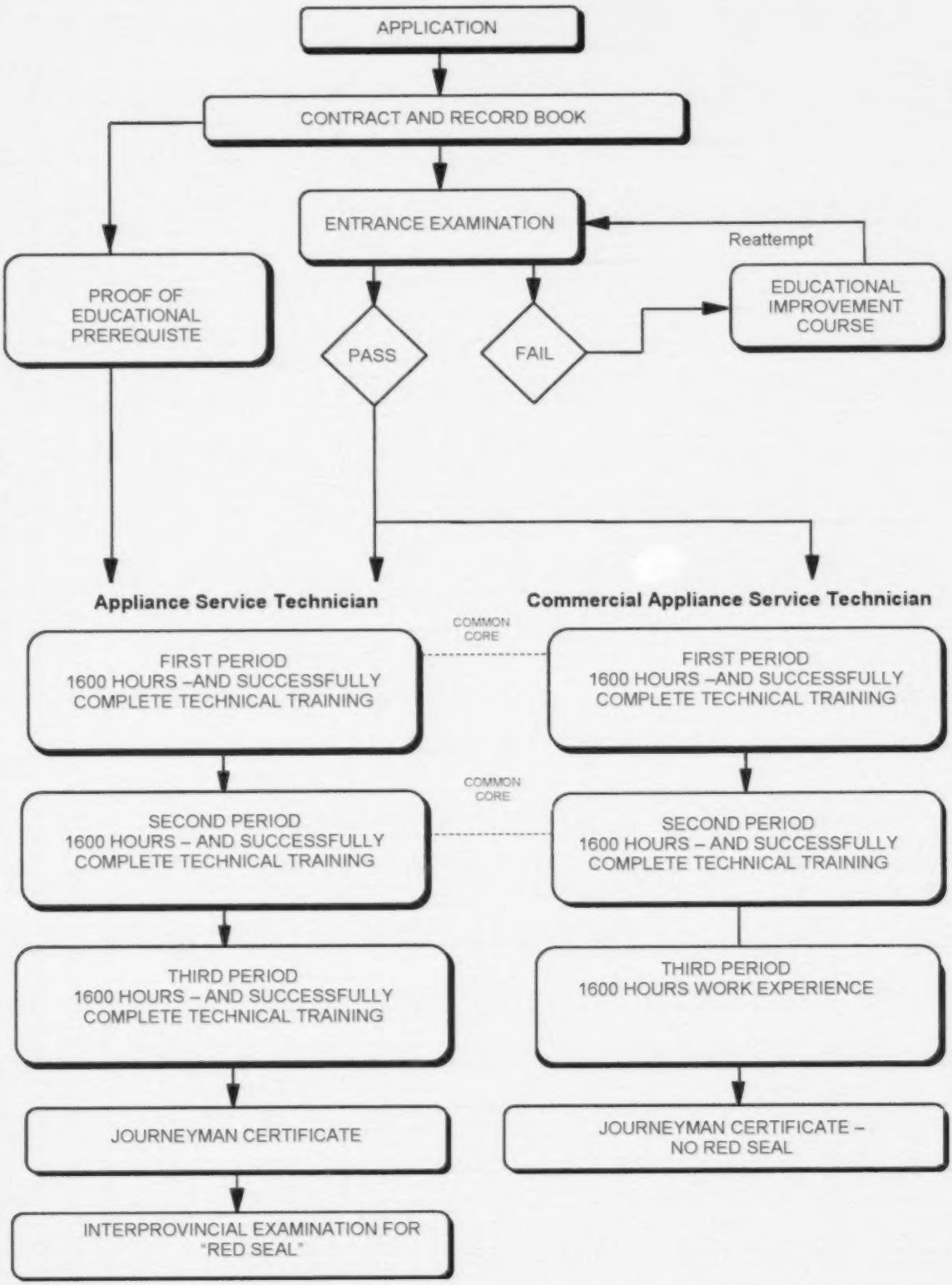
This course outline was approved on December 12, 2014 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Appliance Service Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

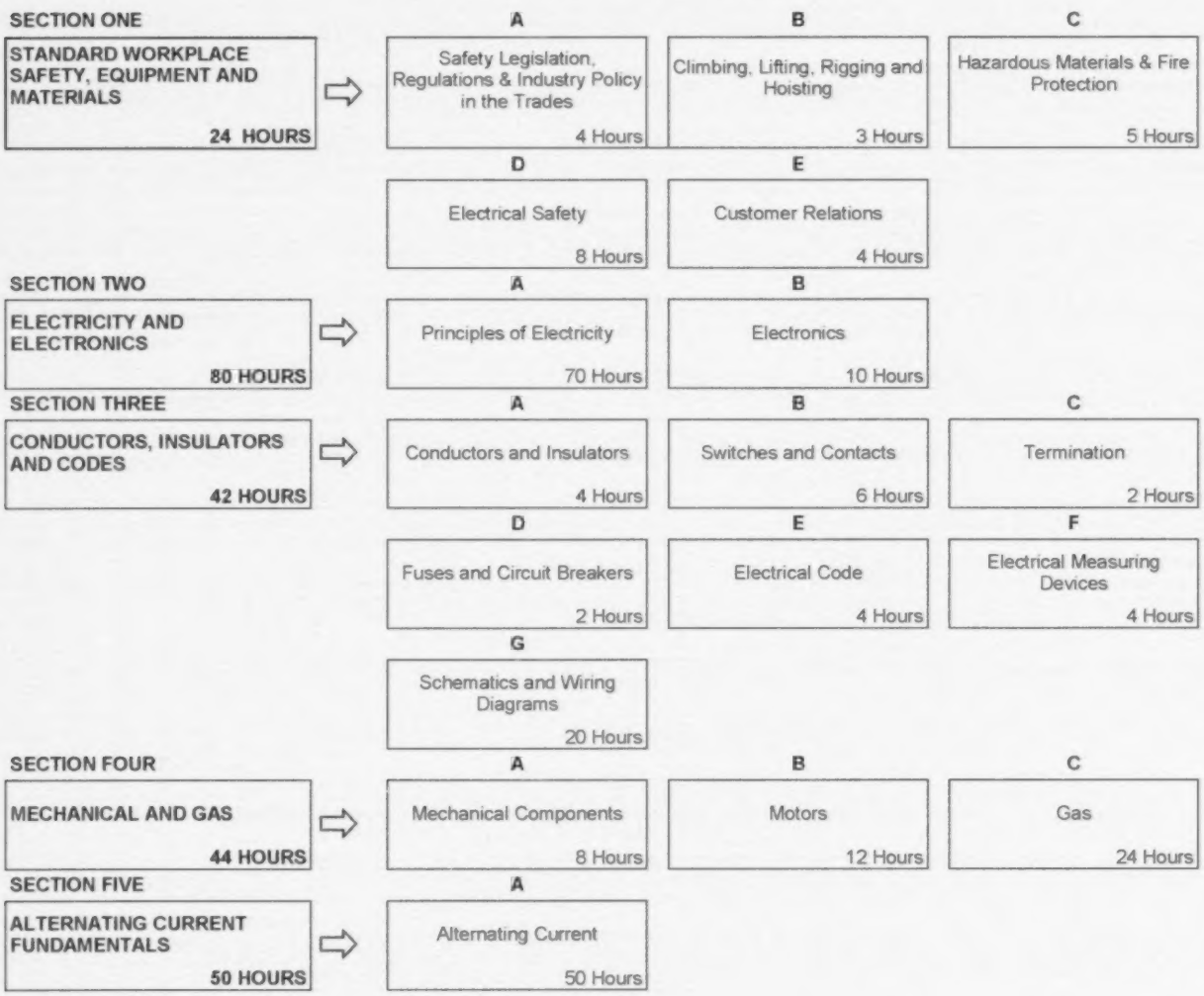
It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Appliance Service Technician Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification **Apprenticeship Route toward Certification**


APPLICATION
CONTRACT AND RECORD BOOK
ENTRANCE EXAMINATION
Reattempt
PROOF OF EDUCATIONAL PREREQUISTE
PASS
FAIL
EDUCATIONAL IMPROVEMENT COURSE
Appliance Service Technician
Commercial Appliance Service Technician
COMMON CORE
FIRST PERIOD 1600 HOURS –AND SUCCESSFULLY COMPLETE TECHNICAL TRAINING
FIRST PERIOD 1600 HOURS –AND SUCCESSFULLY COMPLETE TECHNICAL TRAINING
COMMON CORE
SECOND PERIOD 1600 HOURS – AND SUCCESSFULLY COMPLETE TECHNICAL TRAINING
SECOND PERIOD 1600 HOURS – AND SUCCESSFULLY COMPLETE TECHNICAL TRAINING
THIRD PERIOD 1600 HOURS – AND SUCCESSFULLY COMPLETE TECHNICAL TRAINING
THIRD PERIOD 1600 HOURS WORK EXPERIENCE
JOURNEYMAN CERTIFICATE
JOURNEYMAN CERTIFICATE – NO RED SEAL
INTERPROVINCIAL EXAMINATION FOR "RED SEAL"

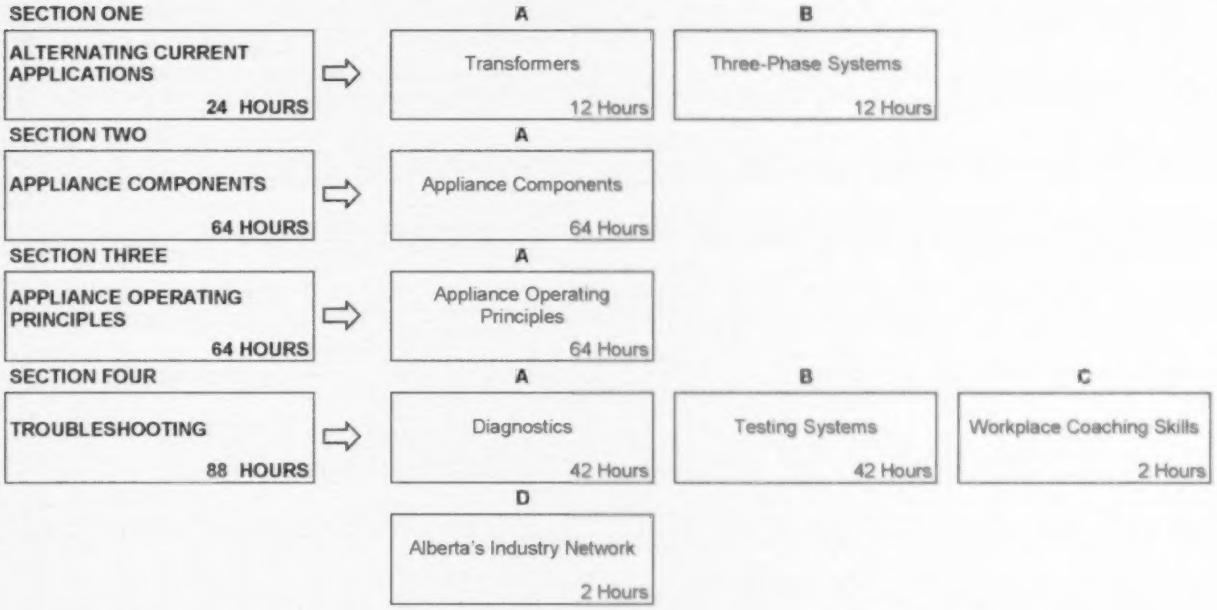
Appliance Service Technician Training Profile

(Common Training for Appliance Service Technician and Commercial Appliance Service Technician
FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

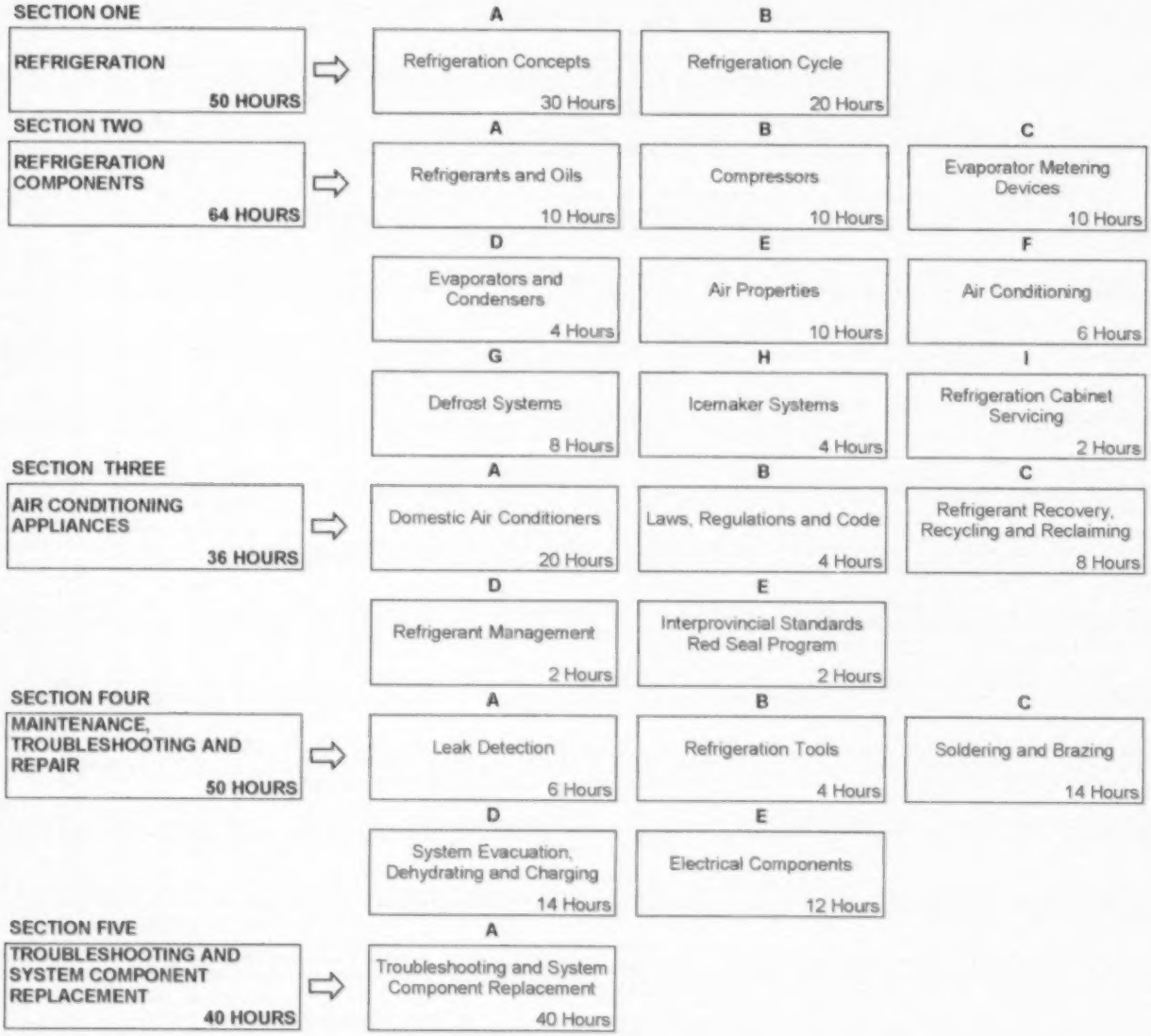


Appliance Service Technician Training Profile

(Common Training for Appliance Service Technician and Commercial Appliance Service Technician)
SECOND PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)



Appliance Service Technician (Only)
THIRD PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)



NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
APPLIANCE SERVICE TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:.....STANDARD WORKPLACE SAFETY, EQUIPMENT AND MATERIALS ..... 24 HOURS

A. Safety Legislation, Regulations & Industry Policy in the Trades .....4 Hours

Outcome: ***Describe legislation, regulations and practices intended to ensure a safe work place in the trade.***

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting .....3 Hours

Outcome: ***Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.***

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection.....5 Hours

Outcome: ***Describe the safety practices for hazardous materials and fire protection in this trade.***

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information systems (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

D. Electrical Safety ..... 8 Hours

Outcome: Apply safe work practices in the workplace.

1. Describe the workplace safety programs in Alberta and safety procedures relating to the trade.
2. Describe the use of hand tools and equipment related to the trade.
3. Describe the use of power and specialty tools related to the trade.
4. Describe lockout procedures.
5. Apply safe work practices in the workplace.

E. Customer Relations ..... 4 Hours

Outcome: Apply aspects of customer relations.

1. Describe customer and co-worker communication techniques.
2. Apply aspects of customer relations.

SECTION TWO: ..... ELECTRICITY AND ELECTRONICS ..... 80 HOURS

A. Principles of Electricity ..... 70 Hours

Outcome: Apply the principles of electricity.

1. Explain the relationship between the structure of the atom and the flow of electrons.
2. Describe the relationship between voltage, current and resistance in an electric circuit.
3. Solve problems using Ohm's law.
4. Verify relationship between voltage current resistance for series, parallel, series-parallel and Edison three-wire circuits.
5. Measure electrical values of a circuit.
6. Identify electrical symbols and terms.
7. Apply Kirchhoff's current and voltage laws to circuits.
8. Identify the application of series, parallel, series-parallel and Edison three-wire circuits.
9. Solve problems involving series, parallel, series-parallel and Edison three-wire circuits.
10. Describe the effect of an open or high resistance neutral connection.
11. Define line loss and voltage drop.
12. Define power and energy.
13. Calculate electrical power, voltage, resistance and current.
14. Calculate electrical energy and cost.
15. Describe electromagnetism and its applications.

B. Electronics ..... 10 Hours

Outcome: Diagnose electronic components and circuit boards.

1. Identify schematic symbols.
2. Describe the purpose and application of schematic symbols.
3. Test electronic boards and devices as per wiring diagrams.
4. Describe static electricity problems during the handling or cleaning electronic circuit boards and connection.

5. Diagnose triacs, diodes, varistors and thermistors.
6. Program microprocessors as per manufacturer's specs.

SECTION THREE: ..... CONDUCTORS, INSULATORS AND CODES ..... 42 HOURS

A. Conductors and Insulators ..... 4 Hours

Outcome: Describe the characteristics and application of conductors and insulators.

1. Describe the characteristics and application of conductor materials.
2. Interpret an American Wire Gauge (AWG) table.
3. Determine wire size required for an appliance.
4. Describe the relationship between resistance, length, cross sectional area and type of conductor material.
5. Explain the terminology relating to conductors on a diagram.
6. Identify the colour and purpose of a conductor.
7. Describe the characteristics and application of insulator materials.

B. Switches and Contacts ..... 6 Hours

Outcome: Test switches and contacts.

1. Explain the application of switches and contacts.
2. Describe the difference in construction and operation of relays.
3. Describe the purpose and operation of thermally operated contacts, overloads and thermostats.
4. Test switches and contacts in relays.

C. Termination ..... 2 Hours

Outcome: Perform electrical connections and terminations.

1. Describe the importance of electrically and mechanically sound connections.
2. Describe the procedure for splicing dissimilar metals.
3. Describe the types and application of terminals.
4. Describe the methods of completing electrical connections.
5. List the characteristics and applications of solders and fluxes.
6. Describe the hazards relating to the use of lead based solder.
7. Describe the techniques for soldering and de-soldering electrical components.
8. Perform electrical connections and terminations.

D. Fuses and Circuit Breakers ..... 2 Hours

Outcome: Describe the purpose and application of protection devices.

1. Define overload and short circuit.
2. Describe the purpose of protection devices in an electrical distribution system.
3. Describe the application of thermal fuses.

E. Electrical Code ..... 4 Hours

Outcome: Apply electrical codes when working with appliances.

1. Describe the object and scope of the Canadian Electrical Code as it applies to an Appliance Service Technician.

F. Electrical Measuring Devices ..... 4 Hours

Outcome: Use electrical measuring devices.

1. Select an electrical measuring device for an application.
2. Select the mode and range for an electrical measuring device.
3. Use an electrical measuring device.
4. Interpret readings on an electrical measuring device.

G. Schematics and Wiring Diagrams ..... 20 Hours

Outcome: Use wiring diagrams and schematics as diagnostic tools.

1. Identify the standard drawing symbols on schematic and wiring diagrams.
2. Develop schematic diagrams.
3. Connect equipment according to the diagram.
4. Develop a schematic diagram from a wiring diagram.
5. Develop a wiring diagram from a schematic diagram.
6. Explain the sequence of electrical operation using bar charts.
7. Use diagrams to isolate electrical failure.

SECTION FOUR: ..... MECHANICAL AND GAS ..... 44 HOURS

A. Mechanical Components ..... 8 Hours

Outcome: Troubleshoot mechanical components.

1. Describe the types of mechanical fastening devices.
2. Describe lubricants and their application.
3. Describe gear reduction ratio.
4. Describe the application of types of seals, gaskets and boots.
5. Perform the installation and maintenance of bearings.
6. Inspect the condition of mechanical components.
7. Replace drive belts, pulleys and couplings.

B. Motors ..... 12 Hours

Outcome: Troubleshoot electrical motors.

1. Describe the operating characteristics and applications of single-phase and three-phase motors.
2. Describe the procedures for installing motor starting devices.
3. Describe frequency and poles for speed control.
4. Describe the types of motor overload protection devices.
5. Troubleshoot electrical motors.

C. Gas ..... 24 Hours

Outcome: Troubleshoot gas-fired appliances.

1. Describe the characteristics and uses of natural and propane gases.
2. Describe safety precautions for handling gases.
3. Identify the fittings used for connecting gas appliances according to the gas code.
4. Explain the gas code installation requirements for ranges, ovens, dryers and barbecues.
5. Describe the characteristics of gas valves used in gas-fired appliances.
6. Describe ignition systems used in gas-fired appliances.
7. Describe safety devices used in gas-fired appliances.
8. Adjust gas and air mixture to pilot and main burner.
9. Test thermocouples and thermopiles.
10. Test electronic ignition systems.
11. Troubleshoot a gas-fired appliance.

SECTION FIVE: ..... ALTERNATING CURRENT FUNDAMENTALS ..... 50 HOURS

A. Alternating Current ..... 50 Hours

Outcome: Apply the principles of alternating current.

1. Explain the theory of sine wave.
2. Define terms relating to alternating current.
3. Define instantaneous, effective and peak values.
4. Calculate instantaneous, effective and peak values.
5. Define units of measurement.
6. Identify the factors affecting resistance.
7. Define phase relationships between voltage and current.
8. Define inductance.
9. Identify the symbol and unit of measurement for inductance.
10. Describe the factors affecting inductance.
11. Define inductive reactance.
12. Identify the symbol and unit of measurement for inductive reactance.
13. Describe the phase relationship between voltage and current in an inductive circuit.
14. Describe the factors affecting capacitance.
15. Describe the construction and characteristics of an elementary capacitor.
16. Describe testing for open and shorts in circuits.
17. Describe capacitor types and applications.
18. Identify the symbol and unit of measurement for the charge of a capacitor.
19. Identify the symbol and unit of measurement for capacitive reactance.
20. Describe the phase relationship between voltage and current in a capacitive circuit.
21. Describe the methods of connecting capacitors in series and parallel configurations.

22. Define impedance.
23. Describe the symbol and unit of measurement for impedance.
24. Identify the formulas required to calculate impedance.
25. Describe the factors affecting impedance.
26. Solve electrical problems using the impedance triangle.

SECOND PERIOD TECHNICAL TRAINING
APPLIANCE SERVICE TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ALTERNTATING CURRENT APPLICATIONS ..... 24 HOURS

A. Transformers ..... 12 Hours

Outcome: Troubleshoot transformer failures.

1. Identify types of transformers used in appliances and their applications.
2. Define the primary and secondary windings of a transformer.
3. Describe standard terminal and winding identification.
4. Describe how transformers are rated and sized.
5. Solve problems involving transformer voltage, turns and current ratios.
6. Describe troubleshooting techniques and procedures to confirm transformer failures.
7. Troubleshoot transformer failures.

B. Three-Phase Systems ..... 12 Hours

Outcome: Describe the characteristics of a three-phase electrical system.

1. Explain the difference between single-phase power and three-phase power.
2. Describe the generation of the phase voltages of a three-phase system.
3. Explain the phase sequence of three-phase sine waves.
4. Describe the advantages of three-phase power over single-phase power.

SECTION TWO: APPLIANCE COMPONENTS ..... 64 HOURS

A. Appliance Components ..... 64 Hours

Outcome: Apply the principles and operation of appliance components.

1. Describe the operation principles and applications of safety devices and switches.
2. Describe the operation of devices used for filling, draining, and measuring of liquids in appliances.
3. Describe the operation of devices used for overflow prevention.
4. Describe the characteristics and applications of dispensing systems.
5. Describe the characteristics of ranges and the accessories available.
6. Describe the operation of hi-voltage components in a microwave oven.
7. Describe the processes for testing the high voltage components in a microwave oven.
8. Describe the characteristics of appliance cabinets and doors.
9. Verify the requirements for installing and commissioning appliances.
10. Apply principles and operation of appliance components.

SECTION THREE: ..... APPLIANCE OPERATING PRINCIPLES ..... 64 HOURS

A. Appliance Operating Principles ..... 64 Hours

Outcome: Explain the operation of appliances.

1. Describe the characteristics and uses of clutch assemblies and transmissions.
2. Describe the characteristics and uses of suspension and dampening systems.
3. Describe the characteristics and uses of pumps.
4. Describe the characteristics and uses of heating systems.
5. Describe the characteristics and uses of condensing systems.
6. Interpret manufacturer's specifications, manuals and drawings.
7. Redraw electric schematic diagrams in different forms.
8. Use bar charts and schematic diagrams for describing circuit operation.
9. Describe the sequence of operation of appliances.

SECTION FOUR: ..... TROUBLESHOOTING ..... 88 HOURS

A. Diagnostics ..... 42 Hours

Outcome: Troubleshoot non-operating appliances.

1. Explain the process of problem solving and analysis.
2. Troubleshoot non-operating appliances.

B. Testing Systems ..... 42 Hours

Outcome: Test systems.

1. Check electrical values using instruments.
2. Identify faulty components.
3. Calibrate controls.
4. Select replacement parts.

C. Workplace Coaching Skills ..... 2 Hours

Outcome: Display coaching skills.

1. Describe coaching skills used for training apprentices.

D. Alberta's Industry Network ..... 2 Hours

Outcome: Describe the role of the Alberta Apprenticeship and Industry Training Board and the network of industry committees that represent the trades and occupations in Alberta advisory network.

1. Describe Alberta's apprenticeship and industry training system.
2. Describe the roles and responsibilities of the Alberta Apprenticeship and Industry Training Board, government and post-secondary institutions.
3. Describe the roles and responsibilities of the PAC's, LAC's and occupational committees.

THIRD PERIOD TECHNICAL TRAINING
APPLIANCE SERVICE TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... REFRIGERATION ..... 50 HOURS

A. Refrigeration Concepts ..... 30 Hours

Outcome: Apply the concepts of refrigeration.

1. Describe the terms relating to the principles of refrigeration.
2. Describe the concepts and methods of heat transfer.
3. Describe the laws of thermal dynamics.
4. Describe the units of measure pertaining to heat transfer.
5. Perform calculations related to heat transfer.
6. Convert temperatures and pressures between various scales.
7. Describe gas laws and how they apply to thermal dynamics.
8. Describe the units of measurement used in refrigeration calculations.
9. Describe formulas used in calculating gas laws and pressure enthalpy.
10. Describe the components of a pressure enthalpy diagram.
11. Plot a basic cycle using a pressure enthalpy diagram.
12. Use formulas for calculating gas laws and pressure enthalpy.

B. Refrigeration Cycle ..... 20 Hours

Outcome: Describe refrigeration systems.

1. Identify the components of a vapour compression system.
2. Describe the conditions of the refrigerant as it flows through the vapour compression cycle.
3. Describe the absorption cycle.
4. Describe the evaporative process.
5. Describe the thermal electric process.

SECTION TWO: ..... REFRIGERATON COMPONENTS ..... 64 HOURS

A. Refrigerants and Oils ..... 10 Hours

Outcome: Describe the properties and characteristics of refrigerants and oils.

1. Describe the requirements for disposing and reclaiming refrigerants.
2. List the desirable qualities of a good refrigerant.
3. List hazards associated with the refrigerant used in domestic refrigerating and air conditioning.
4. Describe each refrigerant including its chemical name and formula and cylinder colour code.
5. Describe the products of combustion of refrigerants.
6. Define viscosity, pour point, miscibility, wax content and flash point.

7. Describe the process of adding or removing oil from a refrigeration system.
8. Interpret environmental protection standards relating to the handling of refrigeration oils.

B. Compressors ..... 10 Hours

Outcome: Describe the operating principles of compressors.

1. Describe the construction, components and operation of compressors used in refrigeration.
2. Describe the compression process and the flow of gas through the compressor.
3. Describe compressor lubrication.
4. Describe the cooling methods used for compressors.

C. Evaporator Metering Devices ..... 10 Hours

Outcome: Describe applications and principles of metering devices.

1. Describe the construction and operating principles of a capillary tube.
2. List the applications of a capillary tube and purpose in a heat exchanger.
3. Describe how to determine evaporator and system superheat.
4. Describe the consequences of an improper charge.
5. Explain the effects of a restricted capillary tube.
6. Describe the construction and operating principles of expansion orifices.
7. Describe the construction and operating principles of expansion valves.

D. Evaporators and Condensers ..... 4 Hours

Outcome: Describe the purpose, operation and test procedures of evaporators and condensers.

1. Describe the purpose and operation of evaporators and condensers.
2. Describe the construction of evaporators and condensers.
3. Describe filter dryer construction.
4. Describe the procedures for testing air flow.
5. Describe testing procedures for evaporators and condensers.

E. Air Properties ..... 10 Hours

Outcome: Describe the characteristics of air.

1. Describe air properties as it relates to heat transfer.
2. Describe methods of heat transfer as they relate to airflow.
3. Describe units of measurement as it relates to air properties.
4. Describe psychometric charts as it relates to air conditioning systems.
5. Describe tools used for measuring air properties.

F. Air Conditioning ..... 6 Hours

Outcome: Describe the processes for conditioning air.

1. Describe how air is conditioned for cooling.
2. Describe how air is conditioned for heating.
3. Describe how air is conditioned for humidifying.
4. Describe how air is conditioned for dehumidifying.
5. Describe how air is conditioned for filtering.

G. Defrost Systems ..... 8 Hours

Outcome: Troubleshoot defrost systems.

1. Identify the types of defrost systems.
2. Identify the purpose and applications of the components of a defrost system.
3. Explain the operating characteristics of a defrost system.
4. Troubleshoot the operation of a defrost system.

H. Icemaker Systems ..... 4 Hours

Outcome: Troubleshoot icemaker systems.

1. Identify the types of icemaker systems.
2. Identify the purpose and application of the components of an icemaker system.
3. Explain the operating characteristics of an icemaker system.
4. Troubleshoot the operation of an icemaker system.

I. Refrigeration Cabinet Servicing ..... 2 Hours

Outcome: Describe the principles, characteristics and service procedures of refrigeration cabinet components.

1. Explain the construction and operational differences between chest and upright freezers.
2. Explain the construction and principles of chest and upright freezers.
3. Describe the procedure for removing, replacing or adjusting doors and their components.
4. Describe the consequences of improperly levelling refrigerators and freezers.

SECTION THREE: ..... AIR CONDITIONING APPLIANCES ..... 36 HOURS

A. Domestic Air Conditioners ..... 20 Hours

Outcome: Service air conditioning systems.

1. List the design and operating principles of window air conditioners.
2. List the design and operating principles of split system air conditioners.
3. List the design and operating principles of portable air conditioners.
4. Troubleshoot air conditioners.
5. Clean air conditioners.
6. Disassemble and reassemble a window air conditioner.
7. List the steps required to test an air conditioning system after installation.

8. Interpret wiring diagrams of air conditioning systems.
9. Draw a wiring diagram for an air conditioning system.
10. Size air conditioning equipment for air conditioning applications.
11. Select air conditioning equipment for air conditioning applications.
12. Describe the general installation procedures for air conditioners.
13. List the servicing requirements of air conditioners.

B. Laws, Regulations and Code ..... 4 Hours

Outcome: Apply regulations relating to handling refrigerant.

1. Describe the Government of Canada's regulations and codes affecting refrigeration and the environment.
2. Describe how the *Environmental Protection and Enhancement Act* impacts the servicing of sealed refrigeration systems.
3. Describe the *Ozone-depleting Substances and Halocarbons Regulation* and the results of non-compliance.
4. Describe the Canadian Standards Association (CSA) *B-52 Mechanical Refrigeration Code.*
5. Identify the government guidelines and applicable codes for the transporting, storage and disposal of refrigerants.
6. Explain the penalties of allowing refrigerant to escape into the atmosphere.
7. Apply regulations relating to handling refrigerant.

C. Refrigerant Recovery, Recycling and Reclaiming ..... 8 Hours

Outcome: Perform procedures for refrigerant recovery, recycling and reclaiming.

1. Describe the procedures for recovering, recycling and reclaiming refrigerant.
2. Describe the procedures for removing contaminants from refrigeration systems.
3. Explain the differences between recycling and reclaiming refrigerant.
4. Describe the procedures when recycling equipment fails during processing.
5. Describe the warranty concerns of appliance manufacturers.
6. Describe the process to return refrigerants to virgin status.
7. Recover refrigeration oils.
8. Dispose of refrigeration oils.
9. Recover refrigerants.
10. Recycle recovered refrigerant.

D. Refrigerant Management ..... 2 Hours

Outcome: Use refrigerant handling techniques.

1. Describe the requirements for transporting refrigerant.
2. Label cylinders containing recycled refrigerants.
3. Use the methods for transferring refrigerant between storage cylinders, charging cylinders and the refrigeration system.

E. Interprovincial Standards Red Seal Program ..... 2 Hours

Outcome: Use Red Seal products to challenge an Interprovincial examination.

1. Identify Red Seal products used to develop Interprovincial examinations.
2. Use Red Seal products to prepare for an Interprovincial examination.

SECTION FOUR: ..... MAINTENANCE, TROUBLESHOOTING AND REPAIR ..... 50 HOURS

A. Leak Detection ..... 6 Hours

Outcome: Perform leak detection.

1. Detect gas leaks using the bubble method and solutions.
2. Detect gas leaks using electronic equipment.
3. Detect gas leaks using dyes.

B. Refrigeration Tools ..... 4 Hours

Outcome: Use refrigeration tools.

1. Describe the required components of refrigerant recycling equipment.
2. Describe the use of refrigerant recycling equipment.
3. Maintain refrigeration tools and equipment.
4. Select refrigeration tools for bending, cutting and connecting tubing and pipe.
5. Use refrigeration tools for bending, cutting and connecting tubing and pipe.

C. Soldering and Brazing ..... 14 Hours

Outcome: Perform soldering and brazing.

1. Describe tools, equipment and material used for pipe work.
2. Describe tools and equipment used for soldering.
3. Describe tools and equipment used for brazing.
4. Describe the safety precautions for the brazing and soldering work area.
5. Describe the methods of protection for components.
6. Prepare material for brazing and soldering.
7. Perform soldering on prepared material.
8. Perform brazing on prepared material.
9. Troubleshoot flow control valves.
10. Replace a compressor.
11. Replace evaporators and condensing coils.

D. System Evacuation Dehydrating and Charging ..... 14 Hours

Outcome: Perform cleaning, evacuating, dehydrating, and charging of sealed systems.

1. Describe the evacuation process.
2. Describe the methods of system evacuation.

3. Connect a vacuum pump and evacuate a refrigeration system.
4. Maintain vacuum pumps.
5. Back flush a sealed system.
6. Sweep charge a sealed system.
7. List the safety precautions to follow when adding refrigerants to systems.
8. Add the correct type and amount of refrigerant to a system.
9. Describe the procedures for testing metering devices.

E. Electrical Components ..... 12 Hours

Outcome: Diagnose electrical components in a refrigeration system.

1. Identify electrical components in refrigeration systems.
2. Use schematic wiring diagrams as an aid in troubleshooting faults.
3. Troubleshoot an electrical circuit within a refrigeration system.

SECTION FIVE: ..... TROUBLESHOOTING AND SYSTEM COMPONENT REPLACEMENT ..... 40 HOURS

A. Troubleshooting and System Component Replacement ..... 40 Hours

Outcome: Repair a sealed refrigeration system.

1. Explain the methods for accessing a sealed system.
2. Diagnose sealed system without refrigeration tools.
3. Diagnose a sealed system using refrigeration tools.
4. Interpret pressure and temperature readings using charts.
5. Describe the types of compressors and their applications.
6. Identify compressor problems of a mechanical nature.
7. Diagnose systems with variable speed compressors.
8. Describe methods of replacing a heat exchanger in a system.
9. Determine when to replace filter dryers.

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